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Play and learn: Influence of gamification and game-based learning in the reading processes of secondary school students☆

Ana Manzano León, José Miguel Rodríguez Ferrer, José Manuel Aguilar Parra*, Juan Miguel Fernández Campoy, Rubén Trigueros, and Ana María Martínez Martínez

University of Almería, Spain

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ABSTRACT

The present study aims to evaluate the effectiveness of an educational gamification program in the reading processes of secondary school students. A quasi-experimental design of comparison between groups with pretest and posttest measurements was carried out with a sample of 271 students (M = 14.42, SD = 0.72). The evaluation battery of the PROLEC-SE reading processes is used. The intervention program consists of 7 or 15 sessions of one hour, and the results of two experimental groups and a control group are compared. The results indicate that, compared to the control group, the experimental groups significantly improve their score in reading processes. The implications of the results obtained, the limitations of the study and some recommendations for future research are discussed and analyzed.

Juega y aprende: Influencia de la gamificación y aprendizaje basado en juego en los procesos lectores de alumnado de secundaria

Palabras clave:
Gamificación
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Procesos lectores
Competencia lectora
Dificultades específicas de aprendizaje
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RESUMEN

El presente estudio tiene como finalidad evaluar la eficacia de un programa de gamificación educativa en los procesos lectores de alumnado de secundaria. Se realiza un diseño cuasiexperimental de comparación entre grupos con medidas pretest y postest con una muestra de 271 estudiantes (M = 14.42, DT = 0.72). Se emplea la batería de evaluación de los procesos lectores PROLEC-SE. El programa de intervención consta de 7 o 15 sesiones de 1 hora, y se comparan los resultados de dos grupos experimentales y un grupo control. Los resultados indican que, en comparación con el grupo control, los grupos experimentales mejoran significativamente su puntuación en procesos lectores. Se discuten y analizan las implicaciones de los resultados obtenidos, las limitaciones del estudio y algunas recomendaciones para futuras investigaciones.

Introduction

Reading processes in the stage of Compulsory Secondary Education

At present, education systems display strong concern for the development of reading processes. In Spain, the stage of Compulsory Secondary Education is characterized by high failure and dropout rates at early ages. Moreover, severe difficulties exist among curricular competences which are closely related to reading processes (Rodríguez-Jiménez et al., 2019).

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* Corresponding author.
E-mail address: jap670@ual.es (J.M. Aguilar Parra).

Among the students most at risk of academic failure are those with specific learning difficulties (SpLD). When students with SpLD do not have the necessary resources, they can face ever greater academic challenges, leading up to 35% to drop out of the education system prematurely (Al-Lamki, 2012). The present study focuses on students with dyslexia, as this group represents a high percentage among SpLDs. Dyslexia is defined as a neurological learning difficulty characterized by difficulties in precision and fluency to recognize written words, as well as decoding and spelling problems. The prevalence of dyslexia at school age varies, ranging from between 7% and 10% of the population (Rello, 2018). The learning deficits caused by dyslexia manifest themselves in functions related to memory, vocabulary, motor skills, speaking and reading processes (Bigozzi et al., 2014). Seemingly following the premise of *the rich-get-richer and the poor-get-poorer*, patterns are perpetuated that cause students with reading difficulties to experience more problems over time, as they possess less vocabulary and knowledge in each subject. Also, unlike their peers, they endure a negative impact on their academic performance (Del Mazo, 2020).

As for the immigrant population, the language used in the classroom does not always coincide with their native language, requiring them to understand a second language (Verhoeven et al., 2018). As a result, these students encounter difficulties to both retain information and to understand texts (Martínez-Antequera et al., 2020). This added difficulty affects their academic performance and represents a challenge to complete their studies (Karoly & González, 2011).

Play strategies to address reading skills

In recent years, a vast array of educational strategies have emerged to address reading skills (Hooley & Thorpe, 2017). Among them, we can highlight the use of gamification and game-based learning (GBL) to motivate students towards learning to read and write. GBL consists of incorporating games into teaching processes. It approaches educational skills in a more motivating way for students, independently of education level (Karakoç et al., 2020).

Educational gamification is defined as the use of elements of play in non-leisure contexts (Deterding et al., 2011). The results of the systemic review by Manzano-León et al. (2021) reveal that its benefits are greater motivation and improved academic results. Recent investigations on gamification in language learning report large effect sizes ($d > 0.8$) (Almache Granda et al., 2020; Berns et al., 2016; Jímenez-Millán & Domínguez-Pelegrín, 2018). However, meta-analyses on education gamification (Kim & Castelli, 2021; Sailer & Homner, 2020) find moderate size effects ($0.5 < d < 0.8$). In these meta-analyses, it is observed that the most controlled variables (independent variable) are the application time of the program and the elements of play utilized, while the study variables (dependent variable) are motivation, behavior and academic performance.

The keys to facilitating gamification are teacher expectations on the use of gamification itself, curricular flexibility and student motivation to play (Saleem et al., 2021). In contrast, Valencia-Quecano and Orellana-Viñambres (2019) cite five barriers to the use of gamification: technology (cost, infrastructure and technical errors); pedagogy (content quality, evaluation and instruction); teachers (attitude and lack of experience); students (lack of exposure to collaborative work, experience, motivation, technological competence and learning difficulties) and design of the play strategy. Both learning play strategies (gamification and GBL) have the potential to respond to the urgent need for motivating and co-educational approaches which adapt to student necessities. The results obtained by Chapman & Rich (2018) reveal that play strategies can be effective and motivating for both sexes. Regarding the duration of the programs, the meta-analysis by Garland (2015) indicates that in order to be effective, the minimum duration of a program must be between one week and six months. More time achieves longer-lasting learning results.

Gamification can be beneficial for students with specific needs who require educational support as it favors collaborative work and facilitates individualization learning processes (Jong, 2019). In the case of students with dyslexia, play strategies can be used that address reading competence. More interest and participation among students is achieved through the creation of fun dynamics (Risqui, 2015). Regarding application with immigrant students, the scientific literature reveals a limitation related to the impact of gamification and GBL on this group. Notwithstanding, studies report the benefits of these strategies in the acquisition of a second language (Dehghanzadeh et al., 2019; Garland, 2015).

With the objective of achieving a positive influence on student learning processes, a gamification and GBL program was designed for the subject Spanish Language and Literature in the second year of Compulsory Secondary School (CSS). While various studies have focused on studying educational gamification to address reading comprehension (Azzouz & Gutiérrez-Colón, 2020; Chen et al., 2020; Li & Wah, 2020), few investigations analyze its use among students with dyslexia or immigrant students (Garland, 2015; Risqui, 2015). These studies highlight the existence of a positive relationship between the use of play strategies and improvement in learning and academic motivation. The following objectives were established: (1) Determine the efficacy of gamification and GBL use in relation to reading processes versus traditional teaching; (2) Verify whether the impact of the gamification and GBL program varies depending on the number of sessions in the program; (3) Evaluate the impact of gamification and GBL on reading processes among immigrant students; (4) Evaluate the impact of gamification and GBL on the reading processes of students with dyslexia; (5) Confirm whether the effectiveness of the gamification and GBL program is independent of sex.

Method

Participants

The sample was comprised of students in their second year of CSS from four high schools in the province of Almeria. Participants were selected using an incidental non-probability sampling, according to the centers and teachers that voluntarily agreed to take part in the study. The control group was comprised of five ordinary classes in second year of CSS and two classes in Programs for the Improvement of Learning and Performance (PILP). Experimental group 1 was comprised of an ordinary class and two PILP classes, while experimental group 2 was comprised of two ordinary classes and three PILP classes.

PILP is a special program for attending second and third year of CSS designed for students with learning difficulties not attributable to lack of study or effort. In this program, the core curriculum subjects are divided into three fields: scientific-mathematics, linguistics and social and foreign languages. PILP classes are aimed at achieving competences that enable students to continue to the fourth year and successfully graduate from CSS. Most of the students in PILP classes in this study had been diagnosed with a SpLD in a psycho-pedagogical report, more specifically dyslexia. No other specific needs for educational support were considered as variables due to the low number of students. With regard to the independent variables studied (sex, immigrant population and dyslexia), data were compiled from each class according to their availability.

The participants were divided into a control group which followed the traditional teaching method and two experimental groups that participated in the gamification program. Experimen-

Table 1
Study participants

	Sex		Age		
	Male	Female	*M*	*SD*	*N* Total
Control	95	48	14.45	0.66	143
Experimental 1 (7 Sessions)	24	21	14.33	0.78	45
Experimental 2 (15 Sessions)	56	27	14.18	0.71	83
Experimental Total	80	48	14.35	0.78	128
Ordinary class					
Control	87	45	13.92	0.64	132
Experimental 1	13	17	14.11	0.71	30
Experimental 2	36	20	14.32	0.76	56
PILP					
Control	8	3	13.84	0.64	11
Experimental 1	11	4	14.13	0.79	15
Experimental 2	20	7	13.92	0.68	27
Dyslexia Control	7	9	13.63	0.72	16
Dyslexia Experimental 1	10	8	14.00	0.68	18
Dyslexia Experimental 2	24	10	13.82	0.67	34
Dyslexia Total	41	27	14.35	0.91	68
Immigrants Control	10	9	14.53	0.51	19
Immigrants Experimental 1	5	3	14.80	0.44	8
Immigrants Experimental 2	11	9	14.53	0.74	20
Immigrants Total	26	21	14.54	0.55	47
Total	175	96	14.42	0.72	271

tal group 1 completed 7 program sessions and experimental group 2 completed 15 sessions (see Table 1).

Instruments

Evaluation of Reading Processes – Secondary School and Baccalaureate (PROLEC-SE; Ramos & Cuetos, 2005). This instrument evaluates lexical, syntactic and semantic processes and the detection of reading difficulties among students between 12 and 18 years of age. The instrument evaluates: (1) *Word recognition*: reading of words and pseudowords, and the timing of each word; (2) *Syntactic processes*: matching drawings to sentences and reading a text which contains different punctuation marks; (3) *Semantic processes*: reading two texts with literal and inferential questions. Reading a text to later complete an outline that represents the structure of the text; y (4) *Reading an explanatory text out loud.*

Procedure

Las Leyendas de Elendor (in English: The Legends of Elendor) is a gamification and GBL program consisting of either 7 or 15 weekly one-hour sessions. The program is based on a medieval fantasy narrative in which each student creates a character with a race (human, elf or dwarf) and class (warrior, wizard or rogue) and must form a clan with four other classmates to work as a team (Gillies, 2016). The teams have to defeat a villain by overcoming different challenges which arise while exploring a virtual map. The program is organized into either 7 or 15 one-hour sessions in the subject Spanish Language and Literature. The one-hour session is distributed into different parts: (1) *Reading and viewing of the daily narrative*: the map of the kingdom is shown. The students can decide where the story will continue; (2) *Daily challenge:* a character asks the students to face a challenge related to the narrative and to reading processes; and, (3) If they complete the cooperative challenge satisfactorily, students can play the selected board games for the last 15-20 minutes of class.

In each challenge, the student groups can win medals, virtual goods and/or experience points depending on how they overcome the mission. These missions are evaluated and scored according to education rubrics (Figure 1).

A variety of board games are selected for the GBL (see Table 2).

Implementation

With regard to the experimental groups, the program was applied thanks to the cooperation of the class teacher and two monitors. Prior to the application, the teachers were trained on the play methodologies utilized and shown the necessary resources. In order to achieve the second objective of the investigation, experimental group 1 engaged in the program for 7 one-hour sessions over two months, while experimental group 2 participated in the program for 15 one-hour sessions over four months. The control group followed the standard curricular content in one-hour sessions in which teachers presented theoretical knowledge using a lecture methodology and photocopied exercises to reinforce the content. Written authorization was requested from the legal guardians of the participants for the purpose of compiling data. Beforehand, teachers were informed that the PROLEC-SE battery would be administered anonymously at the beginning and end of the program and that each student would be assigned a code in order to group and correspond their results from the second application. The second application was conducted 20 weeks later in the three groups. The process is detailed in Figure 2.

This study was carried out according to the recommendations of the American Psychological Association and the Declaration of Helsinki. Ethics approval was obtained from the Research Ethics Committee of the University of Almeria (UALBIO2021/001).

Data analysis

The program *G*Power* was used to calculate the sample size and confirm the statistical power of the study. An $\alpha = .05$ a statistical power $(1 - \beta) = .80$ were considered for all the calculations conducted. The algorithm from O'Brien and Shieh (1999) was utilized.

First, descriptive analyses of the participants were carried out (means, typical deviations), as well as normality confirmation of sample distribution (asymmetry, kurtosis). Next, the reliability of the instruments utilized was verified by means of Cronbach's alpha, McDonald's Omega, the combined reliability and the average variance extracted from each one of the subscales of the measurement instrument PROLEC-SE. Finally, a determination of the efficacy of the intervention was made. At the beginning, a MANOVA was used to verify the equivalence among the groups themselves. Subsequently, the posttest measurements were compared to the pretest

Figure 1. Example of a task within the project.

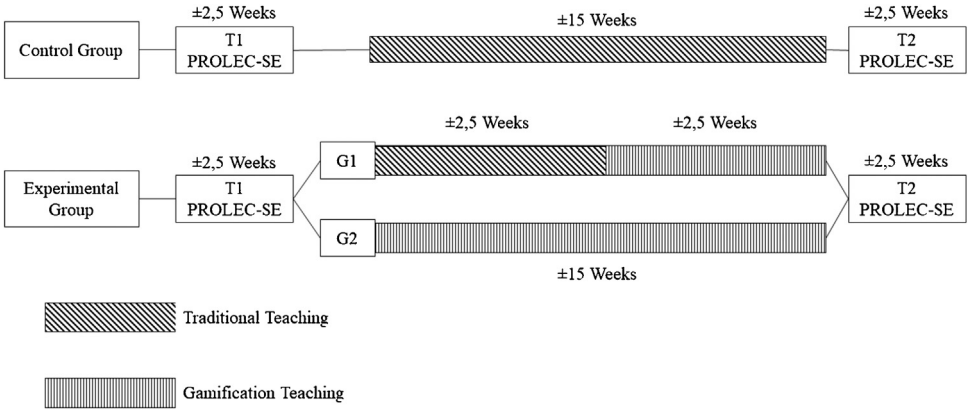

Figure 2. Study flow diagram.

results of each group using MANOVAS, with the differential punctuations (Δd = posttest – pretest) as dependent variables. Cohen's *d* and Eta squared were utilized to evaluate the magnitude of change produced following the intervention via the effect size. A MANCOVA analysis was conducted to assess the influence of sex on the results.

The scientific literature on gamification in language and literature was reviewed for the purpose of calculating the sample size (Almache Granda et al., 2020; Berns et al., 2016; Jímenez-Millán & Domínguez-Pelegrín, 2018). The size effect of these studies was calculated using the following formula:

$$\frac{M_1 - M_2}{\sqrt{\frac{(n_1-1)SD_1^2+(n_2-1)SD_2^2}{n_1+n_2-2}}}$$

The size effects found ($d = 1.11$ in the improvement of oral competence (Almache Granda et al., 2020), $d = 4.47$ in the acquisition of language (Berns et al., 2016) and $d = 0.99$ in performance in the subject Spanish Language (Jímenez-Millán & Domínguez-Pelegrín, 2018)), which are all above 0.80, establish that at least a similar size effect can be expected. The results obtained from the trials demonstrate that the size of the groups is sufficient. Furthermore, the statistical power of the trials conducted was also calculated (MANOVA and MANCOVA 100% of the power of the general MANOVA general and in the MANOVA for students with a different language from Spanish; and 99% for the MANOVA for students with dyslexia; and, finally, 100% for MANCOVA for sex). The statistics package SPSSv26.0 was used to carry out the statistical analyses.

Results

Firstly, Table 3 displays reliability analyses of the instrument. In relation to the first and second objectives, it can be seen in Table 5 that there are no significant differences between the two experimental groups and the control group prior to the intervention, $F(10, 494) = 0.993$, $p = .469$, $\eta_p^2 = .039$. However, the results of the MANOVA for posttest-pretest differences between the groups are significant, $F(20, 494) = 11.531$, $p < .001$, $\eta_p^2 = .318$. Statistically significant differences are found ($p < .05$) in all the variables studied between the three groups and a strong size effect in nearly all cases, and moderate in the rest except in *words*, where the effect was low, as observed in Table 5. According to the post hoc trials, it can be seen that the differences in all cases correspond to the control group with the 15-session experimental group ($p < .01$), and in all cases, with the 7-session experimental group except in *words* ($p = .075$) and *pseudoword speed* ($p = .271$). In all the study variables, higher scores can be observed in the experimental groups, although

Table 2
Board games selected

Name (publisher)	Type of game and components	Curricular content	Key skills
Dixit (Asmodee)	Competitive; Cards and board	OC	LC, SCC
Escuela de dados (Mercurio)	Competitive; dice	LC	LC, LLC
Sherlock Q (Guerra de Mitos)	Cooperative; Cards	OC	LC, SCC
Palabrea (Lúdilo)	Competitive; Cards	OC	LC, LLC
Trapwords (Devir)	Semi-competitive; Card, board, pieces and clock	WC	LC, SCC

Note. LLC: Learning to learn competence, WC: Written communication, CEAC: Cultural awareness and expression competence, LC: Linguistic competence, OC: Oral communication, SCC: Social and civic competence.

Table 3
Reliability analyses

Instrument	α	ω	AVE	CR
Words	.81	.77	.69	.92
Word speed	.83	.78	.71	.95
Pseudowords	.80	.76	.66	.92
Pseudoword speed	.77	.75	.65	.92
Matching	.75	.72	.64	.91
Punctuation marks	.82	.80	.70	.92
Comprehension	.79	.77	.69	.92
Structure	.83	.80	.70	.95
Text speed	.76	.73	.66	.90
Total Battery	.79	.74	.68	.93

Note. α = Cronbach's alpha; ω = McDonald's Omega; AVE = Average Variance Extracted; CR = Combined Reliability.

they are higher in the 15-session group. In short, the group with traditional teaching experienced improvements, but the groups with gamification experienced greater improvements, as shown in Table 4.

As for the third objective, as Table 6 displays, no initial differences can be observed between the immigrant groups in the PROLEC-SE results (both experimental groups were united for this analysis). However, statistically significant differences are observed between both groups following the intervention. The immigrant students with a language different from Spanish in the experimental group improve their results in the PROLEC-SE to a higher degree than those in the control group. The results of the MANOVA for posttest-pretest differences between the groups are significant $F(10, 24) = 3.117$, $p < .011$, $\eta_p^2 = .565$. Statistically significant differences were found ($p < .05$) in most of the variables except *word*, *pseudoword speed*, *punctuation marks* and *text speed* when there was a language different from Spanish. With regard to effect size, it is worth noting the large effect size in *structure*, *comprehension*, *matching*, *pseudowords* and *word speed*, while among the rest of the variables the size effect is moderate or light, as shown in Table 6.

Regarding the fourth objective, Table 7 shows there are no initial differences between students with dyslexia in pretest, but there are in several variables evaluated in the posttest scores. The students

Table 4
Means and typical deviations in each phase of PROLEC-SE scores for experimental groups and control group

	Experimental group (7 sessions)			Experimental group (15 sessions)			Control group		
Variables	Pre *M (SD)*	Post *M (SD)*	Post-pre *M (SD)*	Pre *M (SD)*	Post *M (SD)*	Post-pre *M (SD)*	Pre *M (SD)*	Post *M (SD)*	Post-pre *M (SD)*
Words	38.38(1.71)	39.31(0.68)	0.93(1.84)	38.62(1.86)	39.64(0.53)	1.03(1.81)	38.29(1.96)	38.57(1.87)	0.28(2.23)
Word speed	37.00(8.72)	28.26(4.00)	-8.74(8.66)	35.41(7.71)	24.47(4.46)	-10.94(7.26)	35.83(8.83)	33.15(8.13)	-2.68(4.31)
Pseudowords	36.33(2.70)	38.33(1.76)	2.00(2.64)	35.97(2.98)	39.21(1.01)	3.23(2.84)	36.56(3.20)	36.38(3.58)	0.32(4.27)
Pseudoword speed	51.93(12.77)	42.69(8.81)	-9.24(14.00)	53.10(11.28)	36.78(9.81)	-16.32(13.29)	52.30(16.34)	45.92(12.49)	-6.38(15.65)
Matching	18.81(3.01)	21.38(3.22)	2.57(3.05)	17.40(3.18)	20.44(2.73)	3.04(3.10)	17.63(4.40)	18.21(4.34)	0.58(4.26)
Punctuation marks	18.38(4.63)	23.12(1.08)	4.74(4.42)	18.60(3.17)	23.76(0.53)	5.15(3.05)	18.17(4.05)	20.55(3.86)	2.38(5.19)
Comprhension	7.74(3.23)	13.79(3.24)	6.05(3.74)	7.42(3.13)	14.97(3.35)	7.55(4.47)	8.16(4.35)	9.17(4.35)	1.01(4.85)
Structure	6.60(2.71)	8.50(3.40)	1.90(5.54)	7.38(3.74)	12.01(3.25)	4.63(2.95)	7.00(4.28)	5.40(3.70)	-1.60(4.94)
Text speed	133.38(34.80)	147.60(20.80)	14.21(38.19)	138.19(32.76)	162.85(28.65)	24.65(40.61)	138.50(30.96)	136.01(27.34)	-2.49(20.16)
Total Battery	126.02(12.93)	144.36(6.38)	18.33(15.03)	124.35(10.08)	151.23(7.19)	26.88(9.83)	126.14(15.03)	132.12(13.14)	5.99(21.52)

Table 5
Differences in PROLEC-SE between study groups in each of the phases using ANOVA (pretest and post-pretest)

	ANOVA – 3 Groups						
	Pre			Post-Pre			
Variables	*F*	*p*	η_p^2	*F*	*p*	η_p^2	Post-Hoc
Words	0.748	.474	.006	3.873	.022	.029	CG-EG15**
Word speed	0.486	.616	.004	49.315	.000	.278	CG-EG7*** / CG-EG15***
Pseudowords	0.915	.402	.007	16.298	.000	.113	CG-EG7** / CG-EG15***
Pseudoword speed	0.114	.893	.001	11.430	.000	.082	CG-EG15***/ /EG7-EG15*
Matching	1.964	.142	.015	12.207	.000	.087	CG-EG7** / CG-EG15***
Punctuation marks	0.315	.730	.002	10.962	.000	.079	CG-EG7** / CG-EG15***
Comprhension	0.937	.393	.007	57.103	.000	.308	CG-EG7*** / CG-EG15***
Structure	0.582	.560	.005	54.021	.000	.297	CG-EG7*** / CG-EG15***/EG7-EG15**
Text speed	0.429	.652	.003	20.292	.000	.137	CG-GE7** / CG-EG15***
Total Battery	0.474	.623	.004	35.933	.000	.219	CG-EG7*** / CG-EG15***/EG7-EG15*

Note. CG (Control group, *n* = 143) EG7 (Experimental group 7 sessions, *n* = 45) EG15 (Experimental group 15 sessions, *n* = 83), *N* = 271.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 6
Differences in PROLEC-SE scores between immigrant students with a different language from Spanish belonging to the experimental and control groups

Differences between immigrant students in Control Group and Experimental Group										
	ANOVA									
	Pre-test					Post-Pre				
	CG	EG		CG	EG					
Variables	*M (SD)*		*F*	*p*	η_p^2	*M (SD)*		*F*	*p*	η_p^2
Words	36.00 (3.48)	36.50 (2.70)	.229	.636	.007	2.13 (1.92)	3.00 (2.85)	1.033	.317	.030
Word speed	37.00 (13.55)	39.85 (14.29)	.356	.555	.011	-7.53 (3.31)	-13.75 (10.21)	5.119	.030	.134
Pseudowords	35.73 (3.53)	34.20 (2.59)	2.201	.147	.063	1.67 (2.32)	4.75 (2.31)	15.186	.000	.315
Pseudoword speed	54.87 (15.82)	56.15 (14.97)	.060	.808	.002	-9.93 (14.33)	-16.00 (10.23)	2.139	.153	.061
Matching	17.60 (2.67)	16.85 (3.15)	.552	.463	.016	0.07 (4.01)	4.45 (4.60)	8.656	.006	.208
Punctuation marks	17.93 (4.77)	18.80 (3.78)	.360	.553	.011	3.07 (6.63)	4.40 (4.20)	0.529	.472	.016
Comprehension	7.33 (4.19)	7.90 (3.68)	.181	.674	.005	0.87 (4.64)	6.05 (4.83)	10.205	.003	.236
Structure	6.00 (4.11)	4.80 (3.65)	.833	.368	.025	-1.53 (2.97)	3.7 (3.11)	25.157	.000	.433
Text speed	126.00 (27.42)	121.70 (36.41)	.146	.704	.004	32.47 (14.46)	61.75 (55.93)	3.890	.057	.105
Total Battery	120.60 (17.53)	119.15 (11.34)	.088	.768	.003	12.00 (24.30)	25.65 (14.57)	4.285	.046	.115

Note. CG (Control group, $n = 19$) EG (Experimental group, $n = 28$), $N = 47$.

with dyslexia in the experimental groups improve their PROLEC-SE results to a greater degree than those in the control group. The results of the MANOVA for posttest-pretest differences between the groups are significant $F(20, 112) = 10.056$, $p < .001$, $\eta_p^2 = .642$. Statistically significant differences are found ($p < .05$) in nearly all the variables studied between the groups, except in *word speed* and *pseudoword speed* ($p > .05$) and a strong effect speed in all cases, except in those previously cited without statistically significant words.

Upon examination of the post hoc trials, it is seen that the differences in all cases correspond to the control group with the 15-session experimental group ($p < .001$) (except for *word speed* and *pseudowords*), and in all cases with 7-session experimental group, except in *pseudowords* ($p = .187$) and *text speed* ($p = .165$). All the study variables display higher scores in the experimental groups, albeit they are greater in the 15-session group, as there are variables in which statistically significant differences between both groups, such as *comprehension*, *structure* and *text speed* ($p < .05$). In short, the intervention with students with dyslexia in the experimental groups obtains greater improvements following the application of the program than with the control group, obtaining an even greater improvement in the 15-session group.

Finally, an analysis is conducted to determine whether the effects of the program are the same for boys and for girls. A MANCOVA analysis is carried out with the post-PROLEC-SE variables as dependent variables, sex as an independent variable and the pretest scores as covariables. The results show that the program has the same effects on both boys and girls, $F(10, 109) = 1.149$, Lambda de Wilks = .905, $p = .333$, $\eta_p^2 = .095$.

Discussion

In general, the results of this study suggest that gamification and GBL can prove to be effective tools to improve the reading processes of secondary school students. The strong interest in the use of play strategies for young students owes to motivation and commitment to learning (Hew et al., 2016; Huang & Hew, 2018). However, it is difficult to accurately determine what motivates students when they interact with play systems, as that depends on the player's profile (Marczak et al., 2018). Nonetheless, this aspect is taken into consideration in The Legends of Elendor, designed with a strong game narrative and different techniques and dynamics suitable to the interests and educational needs of the students.

The size effects found in this study are in keeping with those found in previous studies (Almache Granda et al., 2020; Berns et al., 2016; Jímenez-Millán & Domínguez-Pelegrín, 2018). The large and consistent size effects of said investigations confirm that the sample in the present study is adequate.

Gamification and GBL can improve reading habits (Tan, 2018). However, studies on play strategies and reading processes show different results. In their intervention, Chen et al. (2020) demonstrate that although the students with gamification education obtain improvements in immersive experience and social interaction with regard to the control group, they fail to obtain statistically significant differences in reading comprehension performance. However, Chen et al. (2018) indicate that the students who utilize a gamified system improve *academic performance*, *reading speed*, *vocabulary*, *learning habits* and *problem solving*. The results of the present study reinforce this argument, considering that when the gamified program is applied, the experimental group significantly improved their reading competences, which are closely linked to risk of school failure (Bigozzi et al., 2017).

The results indicate that the 7-session program is beneficial in most of the variables studied, but the effect is much greater in the 15-session program. In this line, the scientific literature on play strategies is inconclusive regarding the ideal number of sessions, given that authors like Tobar-Muñoz et al. (2017) suggest that implementing games for two weeks positively influences reading comprehension among students, while Li and Wah (2020) show that a gamification program over the course of a semester proves more beneficial for the more active group than the less active group. However, this investigation highlights that in order for gamification to help improve reading processes, it is advisable to apply the largest number of sessions possible over the course of the school year.

It is seen that the immigrant students that participate in the gamified program display a significant improvement with respect to the control group. The immigrant students may have difficulties in their reading processes in Spanish that hinder their inclusion and access to the curriculum, meaning the implementation of active learning and play strategies can favor their social and educational inclusion (Higueras, 2020). It is considered that gamification and GBL can prove to be effective resources for immigrant students as they actively address reading comprehension in a fun manner, offering the chance to play as a group/class.

Students with dyslexia from the experimental group improve their reading processes in relation to the control group. Other studies argue that students with dyslexia work better when they have practical exercises and learning is multi-sectorial. The use of games for students with dyslexia can reinforce their attention and motivation to learn (Hanghøj et al., 2018). However, it is important that gamification and GBL be designed to be interactive, with increas-

Table 7
Differences in PROLEC-SE scores between students with dyslexia belonging to experimental and control groups

Differences between students with dyslexia in Control Group and Experimental Group													
	ANOVA												
	Pre						Post-Pre						
Variables	CG	EG7	EG15		CG	EG7	EG15						
	M (SD)			*F*	*p*	η_p^2	*M (SD)*			*F*	*p*	η_p^2	*Post-Hoc*
Words	37.88 (1.75)	38.17 (1.34)	38.32 (1.71)	.410	.665	.012	-.88 (1.08)	1.11 (1.53)	1.12 (1.87)	9.103	.000	.219	CG-EG7*** / CG-EG15***
Word speed	40.88 (8.92)	37.22 (7.9)	35.62 (6.63)	2.636	.079	.075	-8.31 (4.06)	-9.28 (9.31)	-9.03 (6.65)	.088	.916	.003	-
Pseudowords	36.00 (4.22)	36.72 (2.70)	35.15 (3.13)	1.378	.259	.041	.13 (5.02)	1.72 (2.85)	3.71 (2.89)	6.134	.004	.159	CG-EG15***
Pseudoword speed	62.13 (23.10)	55.89 (10.37)	53.28 (13.84)	1.676	.195	.049	-16.50 (18.05)	-15.33 (14.31)	-12.74 (15.30)	.377	.687	.011	-
Matching	15.12 (5.44)	16.11 (1.60)	16.85 (2.07)	1.701	.191	.050	0.81 (4.08)	3.44 (3.82)	3.88 (2.77)	4.598	.014	.124	CG-EG7* / CG-EG15**
Punctuation marks	19.50 (3.24)	6.68 (5.37)	18.03 (3.08)	2.300	.108	.066	-2.00 (5.55)	6.50 (5.29)	5.62 (2.90)	20.764	.000	.390	CG-EG7*** / CG-EG15***
Comprehension	9.13 (3.25)	6.67 (2.87)	8.29 (3.36)	1.817	.171	.053	-1.13 (4.50)	8.17 (3.82)	5.71 (4.1)	23.162	.000	.416	CG-EG7*** / CG-EG15*** / EG7-EG15*
Structure	4.13 (3.28)	3.89 (0.90)	4.35 (1.77)	.301	.741	.009	1.81 (3.56)	7.28 (2.27)	5.50 (2.10)	20.189	.000	.383	CG-EG7*** / CG-EG15*** / EG7-EG15*
Text speed	152.13 (44.94)	153.33 (36.69)	142 (35.77)	.671	.514	.020	-20.75 (23.83)	7.28 (2.27)	-4.50 (29.79)	6.558	.003	.168	CG-EG15*** / EG7-EG15*
Total Battery	120.50 (14.38)	120.72 (8.32)	120.32 (9.023)	.038	.963	.001	11.94 (15.86)	24.78 (10.72)	27.24 (12.08)	11.921	.000	.268	CG-EG7*** / CG-EG15***

Note. CG (Control group, $n = 16$) G7 (Experimental group with 7 sessions, $n = 18$) EG15 (Experimental group with 15 sessions, $n = 34$), $N = 68$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

ing difficulty that offers immediate feedback (Manzano-León et al., 2017). Thus, the results of this study, which can be generalized, make a novel contribution to the methodology for working with students with dyslexia. Finally, the investigation into whether sex influences the results of the students who participate in gamified activities revealed no significant differences between boys and girls, as in previous studies (Chung & Chang, 2017). Although promising results are evidence of progress in the field of play strategies as a tool to improve reading processes among secondary school students, there are several limitations. Firstly, the present study is limited by the relatively small size of the sample. Larger and equal samples are needed in order to generalize results, especially in groups of students with dyslexia and immigrants. Another limitation is the sample selection method; considering the data were collected in the natural context of the classroom, it was not possible to balance the groups. However, this limitation is not relevant as no statistically significant differences were found between the groups at the beginning of the intervention. Moreover, the program was applied over a period of time during an academic year, meaning the effect of the play strategies on reading processes could not be determined in the long term. Future investigations could conduct longitudinal studies on gamification and GBL programs that contemplate studies combined with other variables such as school motivation, classroom atmosphere and academic performance.

Conclusion

In conclusion, the results of this study suggest that the implementation of gamification and GBL programs in secondary education can improve reading processes among students. Secondary education is a stage which registers a high rate of school failure and dropout in Spain, and students with reading difficulties are at greater risk. For this reason, it is essential to design and evaluate education strategies that students find motivating. The present study enriches the existent scientific literature and demonstrates that gamification and GBL can prove effective education strategies to contribute to the development of students' reading processes, independent of sex, ethnicity or learning difficulties.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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